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Diseases of Fur Animals



FARMER'S BULLETIN No. 1777

THE NEED for reducing losses from disease on fur farms is felt both by fur farmers and the fur trade. Standardization and intensification in production are demanding a corresponding advance in disease control, and a more critical market is calling for pelts of a quality that can be produced only by animals in good health. Research on fur-animal diseases is yet too recent to make final recommendations possible for controlling all that are now known to be prevalent among the various animals being raised on fur farms. The progress already made, however, by the Bureau of Biological Survey in cooperation with State and other institutions and organizations and with individual fur farmers has developed the methods of disease control here presented.

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DISEASES OF FUR ANIMALS

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INTRODUCTION

THOSE ENGAGED in fur farming in the early days of the industry assumed that their captive animals were much like domestic dogs and that they were susceptible therefore to the same diseases that affect dogs. That the assumption was partly true made it difficult to promote such research on the specific ailments of fur animals as has aided the development of the livestock industry. As a result, many of the more important of these diseases have until recently received little study. It is true that some of the dog's diseases are found in fur animals, but of the diseases now known to affect captive fur bearers there are some that have never been observed in dogs or other domestic animals.

Both the persons who produce fur animals and those who market the pelts are now appreciating keenly the need for maintaining the health of the captive stock. Losses from disease may be disastrous to the fur farmer, and pelts of a quality that indicate good health in the animals from which taken are demanded by the trade and the ultimate consumer. Though sudden death from violence or from a virulent disease may not detract from the value of a prime pelt, debilitating diseases continued over long periods are reflected in lack of luster and other desirable fur qualities.

The most important step in the control of any disease is to make a correct diagnosis. Unless the true nature of an abnormality is known it is impossible to formulate effective methods of treatment. Therefore, in reporting a disease outbreak, the fur farmer can aid in its control by placing before the veterinarian all the facts relating

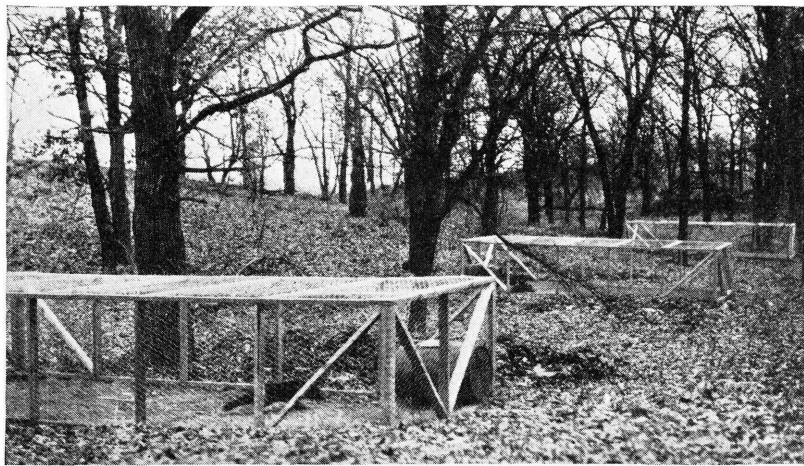
to the general care of his animals, including information on the quantity and kind of feed used as well as its source. To help prevent outbreaks it is of special importance that the producer importing new stock by transferring animals from one ranch to another see that no infectious diseases are introduced along with them.

SANITATION

Losses from disease can be reduced and frequently prevented by systematic sanitary procedure. Prompt removal of accumulations of uneaten food, soiled litter, droppings, and other refuse is important in disease prevention. Not only do many organisms thrive in such material, but it frequently serves as a carrier of specific disease germs from sick animals. Much also can be done to prevent disease by attention to hygienic principles in the selection of ranch sites and the design of buildings.

RANCH SITES AND STRUCTURES

Selection of the ranch site alone may have an important bearing on the effectiveness of sanitary activities. To lessen the chance of spreading disease, it is recommended that the pens be situated at least 10 feet apart on well-drained soil. Ditches should be arranged around the pens, and the ground in the enclosures should be slightly raised so that proper drainage may aid in keeping the pens clean and dry.



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FIGURE 1.—Experimental pens suitable for investigating diseases of fur animals—designed for removal to fresh uncontaminated ground when desired.

The construction of kennels likewise has an important bearing on disease control. The kennels should be so arranged that they may be opened for airing and sunning and for complete disinfection if occasion demands. The outside of the kennels may be painted, but the use of a coal-tar-cresote solution for preserving the wood is preferable. Under no conditions should the kennels so treated be put

into use until they have been well aired out and have had several weeks exposure to the weather. Unless time has been given for a good airing out, the young animals may be injured by absorbing the creosote through contact with the saturated woodwork.

QUARANTINE

Pens suitable for quarantining sick or suspected animals are an important part of the equipment of a well-managed fur ranch (fig. 1). These should be separated from the quarters of the main stock of animals, they should be cared for by separate attendants, and there should be no interchange of utensils. Quarantine pens also should be used for new stock, as the animals can then be observed for a period of several weeks before they are mingled with those already on the ranch. Many disastrous outbreaks of disease on fur farms have originated from the introduction of new stock.

FEEDING EQUIPMENT

It is recognized that the feed room is frequently a center from which disease spreads among animals on fur farms. Unless rigid precautions are taken, latent infections localized in one pen may become active and be disseminated throughout the entire stock through the medium of improperly cleaned utensils or contaminated feed. Not only must the original ingredients of a ration be wholesome, but it is necessary also that they be so stored and handled as to remain so.

Meats exposed to a warm temperature quickly spoil. Many forms of bacteria contaminate meat when it is being dressed. The most satisfactory means of preventing their growth and the consequent spoilage of the meat is refrigeration. When meats are stored under refrigeration it is essential that they be maintained at a uniformly low temperature to prevent bacterial growths. A constant temperature of 34° F. is satisfactory, but keeping the meat frozen at a somewhat lower temperature is more practicable on the average fur farm.

Sick or dead animals should not be brought into the feed room for examination, treatment, or autopsy. Utensils from the feed house that have been used for handling or treating sick stock or for making autopsies should not be returned to that place. They may be effectively sterilized, but as few farm laborers are qualified to do this a special set of instruments and utensils should be provided on every ranch for handling sick or dead animals. These should be kept in a building remote from those used for housing the ranch stock and for storing or preparing the feed.

DISINFECTION

Animals having infectious diseases excrete great numbers of the disease-causing organisms with their saliva, mucus, urine, and feces. It is highly important, therefore, that the attendants utilize every means possible for destroying these organisms in order to prevent further spread of the disease on the fur farm. These disease germs contaminate every place reached by the secretions of affected animals.

The several disease-causing organisms have very different structures and vary in their resistance to disinfectants. Certain general rules, however, should be followed in the process of disinfecting premises and equipment. It is essential to remove all of the litter and waste products commonly referred to as dirt before attempting any chemical disinfection. The structural work of the animal sheds, pens, or kennels as well as the feeding, watering, and handling equipment should be thoroughly scrubbed with soapy water to remove adhering particles containing disease-producing germs. The use of lye (sodium hydroxide) in a 5-percent solution or washing soda (sodium carbonate) is valuable in cleansing surfaces that are scrubbed with a long-handled stiff brush. After this treatment they should be rinsed and treated with a 3-percent saponified cresol or other potent coal-tar disinfectant.

Earthen-floored pens are difficult to disinfect completely. It is advisable to remove the top 2 or 3 inches of soil when it becomes highly polluted and replace it with a layer of new earth, but this is not practicable in large pens. Likewise the expense of application of sufficient chemical disinfectant to large areas becomes excessive. Exposure to the action of the sun and dry air will aid in the destruction of disease germs. Pens that have held diseased animals should remain empty for 4 weeks or longer after the affected stock has been removed and the premises disinfected. If a coal-tar product is used in the kennels and nest boxes it is especially important to leave them open and exposed to the weather for 4 weeks, in order that it may not affect the animals placed in them.

It is often much more difficult to destroy worm eggs than it is to kill disease germs with the common disinfectants. The eggs of some species of parasitic worms are particularly resistant, remaining alive in the ground and being capable of infecting after many months. This is notably true in the case of lungworms. Evidence indicates that the eggs of these parasites may maintain their viability for more than a year in shaded damp soil.

For the destruction of worm eggs in the ground some fox ranchers have resorted to saturating the pens with concentrated salt solutions or with cheap oil. These methods are not completely satisfactory, but they do reduce the extent of pollution of the soil.

INFECTIOUS DISEASES

Contagious or infectious diseases are caused by very minute organisms. Some of these are classed as protozoa, a primitive form of animal life; some are of a bacterial form, a low order of plant life; and still others are caused by filtrable viruses in which the infective agents are so small that they cannot be seen with a powerful microscope and will pass through a porcelain filter. All these types of organisms, frequently referred to as germs, multiply rapidly in suitable environment, and they become numerous in sick animals, which liberate them in great numbers. When they gain entrance to the bodies of susceptible stock they reproduce the disease.

Since pathogenic organisms may be transferred from sick to healthy animals by means of feces and secretions, infections may be induced by direct contact or by using contaminated feeding and

watering utensils or any article of fur-farm equipment that has been carelessly handled.

When disease outbreaks occur on fur farms they are frequently complications of two or more infections, the symptoms of which are difficult to differentiate. Further difficulties may also result from parasitism and improper feeding and poor hygiene in general. Treatments for infectious diseases can be made most effective when the animals are reasonably free from parasites and are properly housed and nourished.

DISTEMPER

The term "distemper" is frequently applied to various prolonged ailments during which the animals fail to eat normally and show a loss of flesh. True canine distemper is caused by a filtrable virus and may be communicated to foxes from dogs that are affected. It is easily spread among foxes under the conditions prevailing on the average fur ranch. Evidence on the susceptibility of minks to this disease, particularly in its epizootic form, is incomplete.

In foxes affected with distemper an acute condition usually develops after a few days of incubation following exposure. There is listlessness and a distinct loss of appetite, and the animals manifest symptoms of fever. Bloody diarrhea is frequently observed, and the fur will show an unkempt appearance. Closer examination discloses a dry muzzle, though there may be a watery discharge from the nostrils, and this may become somewhat purulent (containing pus) after a few days. The conjunctiva (the mucous membrane covering the eyeball and the inner side of the eyelids) is almost invariably exceedingly reddened. If the disease is not fatal after a few days, there is usually a watery or purulent discharge for some time from the eyes as well as from the nose. It is during the early stages of the disease that one animal is most likely to infect others associated with it. The virus is also readily carried by attendants from pen to pen, and thus it is not unusual for the infection to appear simultaneously in various parts of a ranch.

Autopsy frequently fails to reveal such significant changes in the organs as would definitely prove the presence of canine distemper. The spleen and liver are likely to be slightly enlarged and somewhat darker than usual. The flesh may have a somewhat anemic (pale) appearance and occasional very small hemorrhagic spots. The stomach and intestines are generally empty of food materials, because of lack of appetite preceding death, though it is not unusual to find an excess of mucus tinged with blood. The mucous membrane lining the stomach and intestine often exhibits extensive reddening due to inflammation.

There are two principal methods of controlling an outbreak of canine distemper on a fur ranch. The first requires the most rigid isolation and quarantine of affected and exposed stock and liberal use of approved methods of disinfection. This is essential to avoid infecting all the animals on a ranch. Since canine distemper is so easily spread, those engaged in the ranch operations of feeding and caring for the animals cannot be too careful to avoid carrying infective material.

The second method involves the use of vaccine and serum produced by reputable biological laboratories. Because of the sensitive qualities of these biological products and the complications that may arise in an outbreak of canine distemper, they should be handled only by a practicing veterinarian.

One should not expect too much from any treatment or any preventive preparation. At best these only aid in strengthening natural qualities of immunity in individual animals. Without treatment for this disease, as many as 80 or 90 percent of the animals on a ranch may become infected. If, however, a correct diagnosis has been made and potent preparations are properly administered in adequate doses, the rancher can expect to be well repaid for his trouble and expense in the animals saved. It is questionable, however, whether the use of a live virus should be resorted to with the expectation of establishing permanent immunity against this disease in foxes.

PARATYPHOID INFECTION

Paratyphoid infection is a bacterial disease that may attack a variety of animals and man. On numerous occasions it has made its appearance on ranches to which animals have been brought from other places. Its spread, like that of most infectious diseases, is brought about by contact with diseased animals, contaminated objects, or food. It frequently runs a course of 2 to 3 weeks.

Foxes in the early stages of infection show a loss of appetite and lack of luster in the coat. A gradual loss of flesh is noticed, and a dry muzzle with usually a watery or purulent discharge from the nose and eyes follows (fig. 2). Diarrhea or constipation may be in evidence. In some instances, the feces may be stained with bloody streaks, especially when death is near. When paratyphoid cases extend over long periods, there is frequently great emaciation, sunken eyes, and evidence of extreme weakness.

Post-mortem examination of acute cases reveals little change in the carcass. Loss of flesh corresponds to the duration of the disease, and in the more chronic cases emaciation may be extreme. In some cases the lungs show a collection of fluid that may be described as hypostatic congestion or hypostatic pneumonia. Sometimes the liver may be slightly enlarged and somewhat lighter colored than normal.

It is in the spleen that the most pronounced change is usually found. This organ is dark, frequently several times its normal size, and of a pulpy consistency. It breaks easily and is engorged with dark blood. From its interior it is often possible in the laboratory to obtain pure cultures of the paratyphoid bacteria.

A condition that frequently accompanies paratyphoid infection in foxes is jaundice. Ordinarily, however, this should not be regarded as a specific disease but rather as a symptom. It is possible that it is accentuated by the invasion of the animal's body by other pathogenic organisms at the time. In a jaundiced animal all of the tissues are definitely yellow in color. This is the result of failure to eliminate bile through the digestive canal and its absorption by the other organs and tissues.

Control of paratyphoid infections on a fur ranch consists in adherence to strictly sanitary methods in the process of feeding and caring for the animals, and appropriate treatment of the diseased

individuals. Affected and exposed stock should be kept under strict quarantine. When a single attendant looks after all the animals on a ranch, the healthy stock should be cared for first. After working with diseased animals, he should thoroughly wash and disinfect his hands and shoes and remove the outer clothing, which may have come in contact with affected foxes or their excrement, and disinfect it before it is again used.

Outbreaks of paratyphoid infections on a fox ranch may be effectively checked by means of a bacterin prepared in laboratories



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FIGURE 2.—Fox with paratyphoid infection, showing characteristic purulent discharge from eyes and nose.

equipped for this type of work from the strain of organisms occurring on the ranch. Bacterins and vaccines should be administered by a practicing veterinarian, or if one is not available, the products should be given in strict accordance with directions furnished by the laboratory.

Since several closely related strains of paratyphoid bacteria may attack foxes, and since the various strains do not effectively cross-immunize against each other, it is necessary to send to the laboratory one or several carcasses in a good state of preservation, so that the bacterin may be made from the organisms present and appropriate

for the existing infection on that particular ranch. Carcasses for this purpose should be delivered as soon after death as possible to the commercial laboratory making the bacterin. No chemical preservative should be used. If the carcasses cannot be delivered within a few hours after death, they should be kept from putrefaction by refrigeration. Placing solid carbon dioxide in the shipping container is the most satisfactory way to prevent spoiling.

ENCEPHALITIS

A disease generally referred to as fox encephalitis, affecting particularly the brain and nervous system, has been observed in foxes, and a similar disease probably occurs in minks. It may become prevalent, though on well-regulated ranches there is usually ~~not enough contact between~~ animals of different breeding pens or transfer of materials for the disease to assume epizootic proportions.

Ordinarily the mortality rate is low, and the infection may kill an occasional animal from time to time before the owner is aware that contagion is present on his ranch. Under poor hygienic conditions or when numbers of foxes mingle on a fur range, there is danger that animals carrying a chronic infection, which are spoken of as carriers, may convey the disease to a large proportion of the stock. In instances of this kind, the losses may be extensive and come in rapid succession. Outbreaks have been known to kill 40 percent of the foxes on a ranch within a period of a few weeks.

Fox encephalitis, like canine distemper, is caused by a filtrable virus. The diseases are distinctly different in various ways, however, and infection with one does not immunize against the other. The virus of encephalitis appears to have a special affinity for the brain and central nervous system, although it is found in various body tissues and secretions.

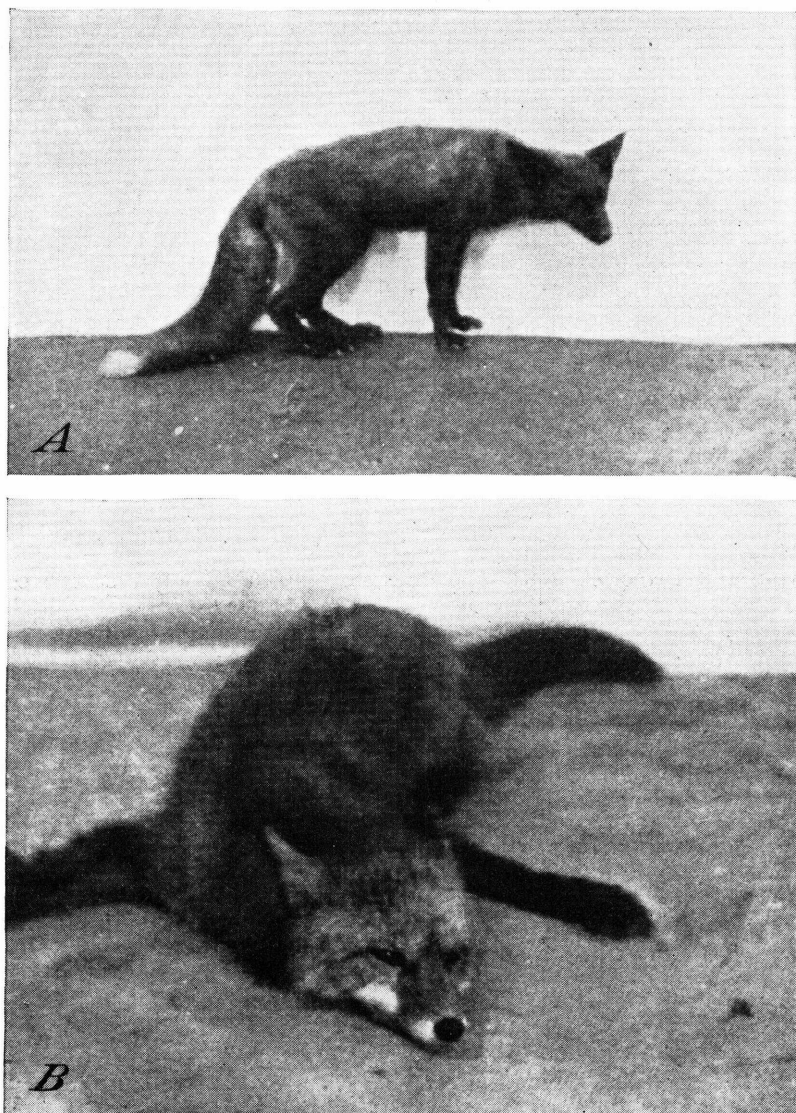
Because of its particularly destructive effect on the brain and important nerves, fox encephalitis usually causes rather quick death. Animals succumbing, therefore, usually die in normal flesh and show no effects of debilitation. When symptoms are observed, they are of a nervous character, sometimes taking the form of convulsions, paralysis, or lethargy (sleepiness) (fig. 3, *A* and *B*). Occasionally a bloody diarrhea may be noted. Frequently, however, when the attendant finds an animal dead and sees no evidence of sickness he assumes that it died of indigestion or was killed by its pen mate, and even autopsy may fail to develop sufficient evidence to lead to a diagnosis.

Without a well-equipped laboratory it is difficult to identify the infection. Lesions in the brain, spinal cord, and occasionally in other organs, as seen under the microscope, are characteristic and may be relied upon as the basis of a definite diagnosis when studied by an experienced pathologist.

Experimentally, losses from fox encephalitis have been greatly reduced under controlled conditions by artificial immunization with a specially prepared vaccine administered when the animals are only a few months old. During an outbreak animals may be temporarily protected for a period of about a month with a hyperimmune serum.

Studies are in progress for perfecting these products so that they can be economically made by commercial biological laboratories as a practical means of controlling the disease.

Without the aid of effective biological products for checking an outbreak of fox encephalitis, the only practicable method to be recom-



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FIGURE 3.—Encephalitis in foxes: A, Stupid, or lethargic stage; B, paralytic stage.

mended is isolation and quarantine restrictions. No interchange of equipment or supplies between pens should be permitted. As a

further precaution all recovered and exposed animals that have been associated even remotely with diseased stock should be disposed of at pelting time. By this process it may be possible to eliminate individuals that might otherwise serve as carriers of the infection.

INFECTIOUS ENTERITIS

A number of bacteria belonging to the salmonella group and producing intestinal infections frequently are introduced onto fur ranches by contaminated feed or by new animals brought from infected sources. These organisms thrive in the digestive tract and cause an acute inflammation of the mucous membrane, especially that lining the small intestine. The disease, termed "infectious enteritis", runs a course of 1 to 3 weeks. The onset is marked by lack of appetite and a slight diarrhea, which rapidly becomes more pronounced, and the feces are streaked with blood. Often there may also be seen a slight watery discharge from eyes and nose. Affected animals lose flesh rapidly, but death generally comes before extreme emaciation develops.

No form of biological product, such as bacterins, vaccines, or serums, is of any recognized value in the treatment of infectious enteritis. The use of drugs or combinations of drugs also has given very indifferent results. On a few ranches where tried, however, the use of buttermilk, preferably made by the action of *Lactobacillus acidophilus*, in the ration has had a definitely beneficial effect. This is given in a mixture of ground meats and cereals, sufficient buttermilk being added to give the desired consistency. It is assumed that the beneficial effect of this treatment is derived from the lactic acid or other products of the growth of the *Lactobacillus acidophilus* when they become established in the intestinal tract.

The so-called intestinal antiseptics seldom are sufficiently effective in rendering innocuous the bacteria of the digestive tract; hence the free use of disinfectants about the premises is to be encouraged. Coal-tar disinfectants used in pens and kennels where sick animals have been confined will aid in preventing the spread of the disease. The same products, or probably better still, chlorine disinfectants, may also be used for the food and water utensils. If coal-tar disinfectants are used, the pans and utensils should be well washed in hot soapy water and rinsed in clear water before again being used.

PNEUMONIA

Pneumonia occurs in fur animals usually as a secondary affection following some predisposing factor, such as lungworm infestation. Animals subjected to cold or drenching rains and subsequently exposed to cold winds that may lower their physical resistance are easy victims of this disease. When an animal has contracted pneumonia, good nursing is the best means of saving its life. It is highly important that it be kept dry and in a moderately warm uniform temperature. The fumes from aromatic oils, generated by placing the oils in hot water, stimulate respiration and release the mucus from the lungs and trachea. Easily digested foods, which have been warmed, should be given in small quantities, but at more frequent intervals than to healthy stock.

MISCELLANEOUS INFECTIONS

Other infections frequently make their appearance on fur ranches without being recognized as definite diseases. This is usually because they are not so highly virulent for fur animals as are those already described. As a rule they do not spread so rapidly, and the mortality is not so great as in the specific diseases that have received more detailed study. In a few instances, however, the nature of the organism causing the trouble has been recognized. As an example, tuberculosis has been found occasionally among silver foxes on fur farms. The infections have not developed to the proportions of an epizootic, but are probably individually acquired from ingesting meat taken from tuberculous cattle or other animals.

It is suggested that in cases of obscure symptoms the caretaker make a very careful search for the cause of the sickness by considering the type and quality of the feed before it is concluded that the disease is infectious. If there is evidence of an infection, one or several well-preserved carcasses should be transmitted to a nearby reliable biological laboratory that is equipped for making diagnostic examinations and preparing bacterins for immunization against the specific organisms.

INTERNAL PARASITES CAUSING DISEASE

Parasites are forms of animal life that live in or on and at the expense of a host. Since they so live they cause more or less injury to the host. Some parasites are relatively harmless to animals that are well nourished or in good health. Others, however, are more injurious, not only because of the physical injury they inflict but also because by sucking blood or in other ways they apparently produce toxic substances that injure the tissues.

ASCARIDS

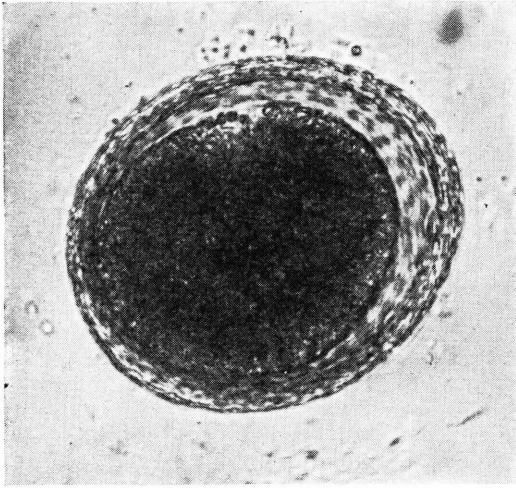
Ascarids, which are large roundworms, are present on most fox ranches. Mature *Toxocara canis*, the species commonly found in the fox, are 2 to 4 inches long and are yellowish white in color. They do not attach themselves to the intestinal wall but subsist on the intestinal contents and liberate toxic substances that cause definitely ill effects when absorbed in quantity by the host animal. This is especially true in stock 2 weeks to 5 months old. Ascarids similar to those of foxes occur in minks, but these parasites seem to be scarce in this country.

Animals infested with these worms may have an irregular appetite and a dry, lusterless fur. A general unthrifty condition is apparent, especially if the infestation is heavy or of long standing. The worms interfere with the peristaltic movement of the intestine and, if numerous, may cause complete obstruction. Infested fox pups are more likely to exhibit a rachitic condition, since these worms appear to interfere with the proper digestion and assimilation of food.

Animals get roundworms by eating food contaminated with the droppings of parasitized stock or by licking their fur after it has been in contact with contaminated soil or equipment. It is recom-

mended, therefore, that an examination of the breeding stock be made before the mating season in order to detect roundworms and to reduce the opportunity for heavy infestation of young fox pups and that affected animals be treated with proper anthelmintics. An experienced person can readily identify the eggs in the feces of parasitized animals by means of a microscope (fig. 4).

Oil of chenopodium, at a dose rate of about 0.025 to 0.05 cubic centimeter per pound of body weight, combined with at least 10 times the volume of castor oil, is the most effective drug for the removal of ascarids. It may be advisable to have it prepared by a



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FIGURE 4.—Ascarid egg from fox, enlarged about 550 times.

trained pharmacist, since care must be taken not to overdose the animals, because of the severe action of this drug. Tetrachlorethylene, at a dose rate of 0.1 cubic centimeter per pound of body weight, though somewhat less effective, is a safer preparation. Treatments for the removal of intestinal worms should be given on an empty stomach and should be accompanied with some purgative. Castor oil makes a good combination with oil of chenopodium, and Epsom salt or phenolphthalein is suitable for use with tetrachlorethylene.

HOOKWORMS

Hookworms of the species *Uncinaria stenocephala* are present on most fox ranches. Other species also may occur, but all are spread in the same manner, and for all the same treatment is recommended. Infestation takes place through the mouth or directly through the skin. Small larval hookworms hatch soon after the eggs (fig. 5, A and B) are passed with the feces. These may gain entrance to the new host in food or may burrow through the skin and eventually reach the intestinal tract. Usually hookworms do not become numerous until the pups have been out of the kennels for several weeks.

These parasites are a quarter to half an inch long, whitish in color, and attach themselves to the mucous membrane lining the small intestine. Anemia and unthriftiness, resulting from the bloodsucking activities of parasites in the intestinal tract, are characteristic symptoms, but definite diagnosis of hookworm infestation can be made if the eggs are found in examining the feces.

Tetrachlorethylene, administered at the same dose rate as for roundworms (0.1 cc per pound of body weight), is the preferred drug for removing hookworms and is usually completely effective in removing the worms present in the intestine of an animal if administered with a suitable purgative. The animal should be fasted for 24 hours previous to treatment. It is frequently advisable on ranches where there is a heavy hookworm infestation to repeat the treatment in 12 to 15 days in order to remove the young worms that were in the process of migration in the body tissues but not in the intestinal canal at the time of the first treatment.

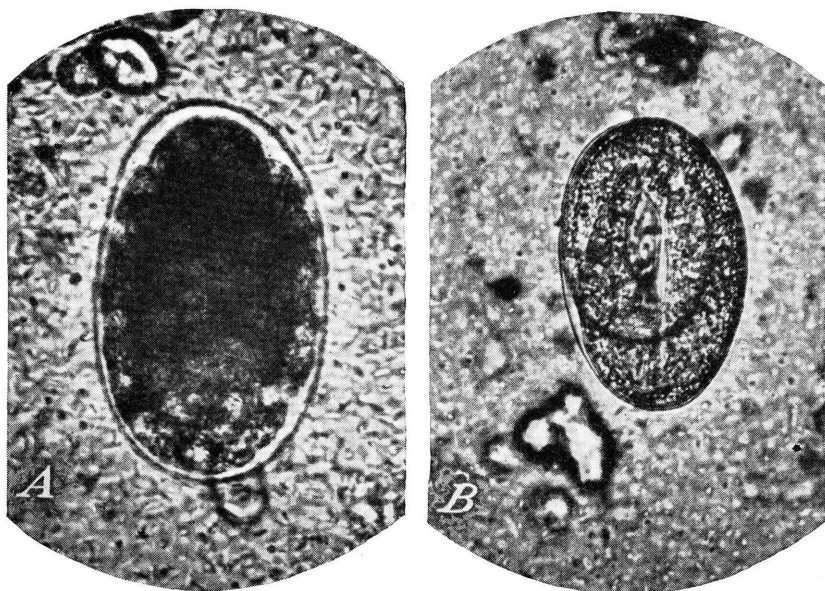
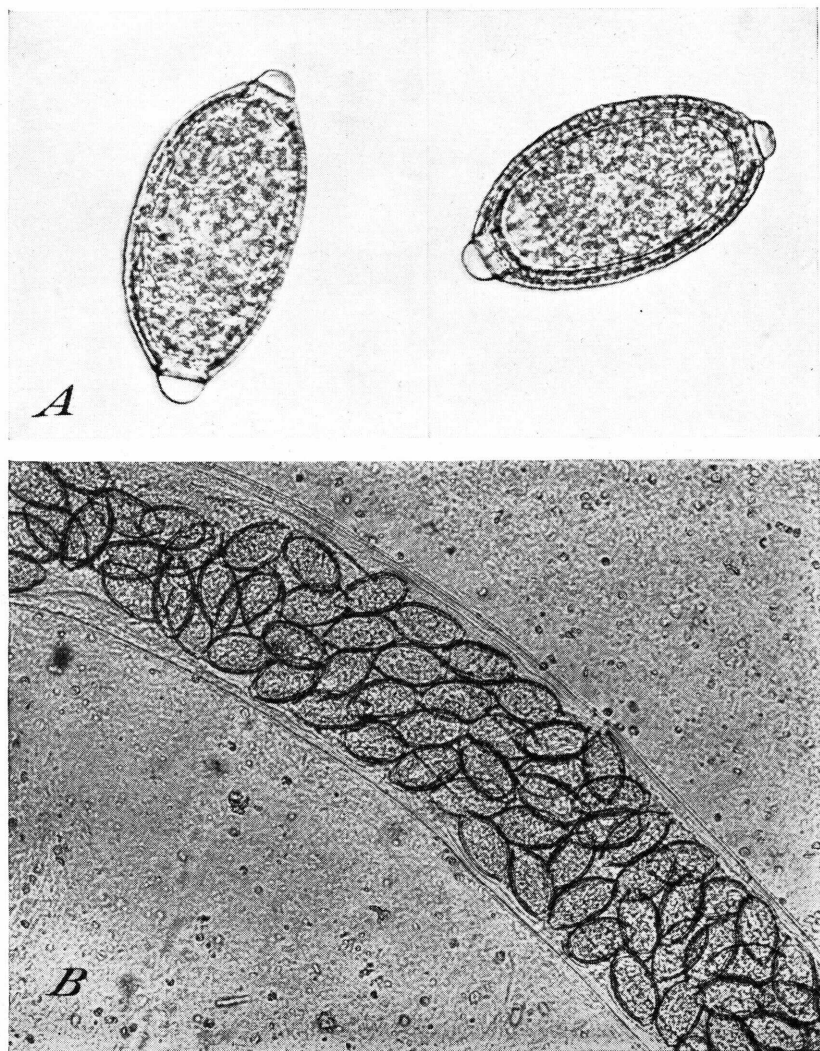


FIGURE 5.—Hookworm eggs from intestine of fox: A, Soon after discharge (magnified 620 times); B, several hours after discharge—the coiled worm can already be seen (magnified 460 times). (Courtesy of W. A. Riley, University of Minnesota.)

LUNGWORMS

Lungworms, usually the species *Eucoleus aerophila*, but occasionally *Crenosoma decorotum*, may become a serious plague on fox ranches. Infestations among foxes appear to have become widespread during the last few years. The worms in their immature stage are lodged in the minute air passages and tissues of the lungs, usually near the margins of these organs. As they mature they find their way into the larger air passages. Here they remain relatively quiet, but their presence causes an accumulation of mucus, which produces a mild bronchitis. Infestation with lungworms, like worm parasitism in the intestinal tract, can be definitely diagnosed by microscopic examination of the feces, since the eggs from the worms in the bronchi and trachea are worked up to the pharynx with the mucus, swallowed, and passed out with the feces (fig. 6).

A practical and reasonably accurate diagnosis can be made by observation of symptoms. The accumulation of mucus in the air passages causes frequent coughing, and if the animals are exercised a wheezing or rattling sound can be detected in their breathing.



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FIGURE 6.—Lungworm eggs from fox: A, Eggs enlarged 550 times; B, part of body of lungworm, showing the enormous capacity for egg production.

Medicinal treatment of affected foxes is of little value. Mechanical removal of the worms is impracticable, and furthermore only those in the trachea could be reached in this manner. The use of pens with dry board or wire-mesh floors is the most practicable means of control for lungworm infestation.

BLADDER WORMS

Small threadlike parasites (*Capillaria plica*) of the urinary bladder may at times become numerous in foxes. A few bladder worms may be present without causing serious consequences, but heavy infestations may be accompanied by a subacute catarrhal inflammation of the bladder lining. There is no known treatment, and control is best achieved by following sanitary procedures.

TAPEWORMS

Tapeworms of several species have been found occasionally in silver foxes and minks raised on fur farms. In wild-ranging animals, these parasites are much more common. Since the larval stages of the various tapeworms in fur animals occur in different hosts, some in fish and others in small rodents, it is advisable not to feed uncooked fish and rodents to these animals.

The use of arecoline hydrobromide, in doses of one-eighth to one-quarter of a grain for foxes, is recommended, with a proportionately smaller dose for minks.

FLUKES

Flukes of the species *Alaria americana* are sometimes found in the intestines of ranch foxes, and related flukes in ranch minks, although not so frequently as in wild-ranging animals. These flat oval worms are about one-sixteenth of an inch long, and in their development require several intermediate hosts. Minks usually become infested by eating mice or other small mammals.

Minks are also sometimes affected with flukes of the species *Parametorchis canadensis* in the liver and gall bladder. These are more pathogenic than intestinal flukes, and heavy or long-standing infestations cause degeneration of the liver and an irregular appetite. Avoiding the use of uncooked aquatic food will prevent infestation.

Some investigators have reported beneficial results with minks from the use of small doses of carbon tetrachloride, as in the case of other animals having similar types of infestations. The dose should not be in excess of one or two drops for an adult mink. An effective purgative should be given with the treatment.

COCCIDIA

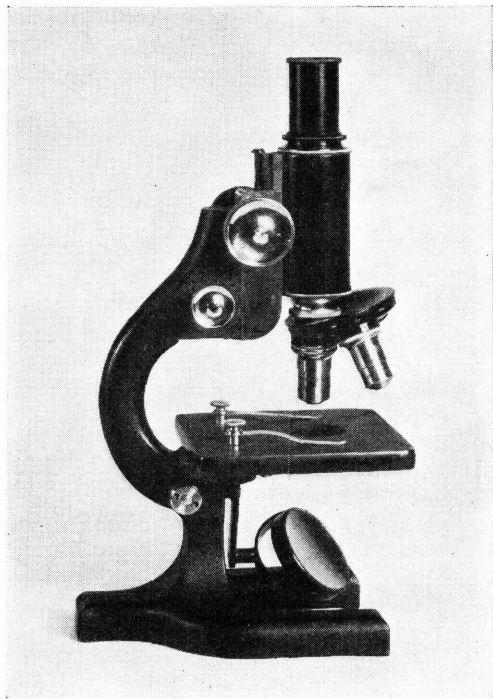
Coccidiosis, caused by several species of minute protozoa, has been reported in both foxes and minks, but is more injurious to minks than to foxes. The species *Isospora bigemina* is considered to be the most prevalent. Ordinarily a few coccidia are present on most fur ranches, and under certain unknown conditions they become numerous and highly pathogenic. An excess of mucus in the droppings is one of the first symptoms. Soon the droppings become tinged with blood, and irregular diarrhea is in evidence. The coat is harsh, and progressive loss of appetite and wasting of flesh ensues. The disease often ends in death in minks and occasionally in foxes.

Usually an outbreak of coccidiosis runs its course in a few weeks, and the losses cease without special treatment. Diets containing a high proportion of milk, preferably buttermilk, are recommended. Since the organism in the infective stage gains entrance to susceptible

animals through the mouth, the exercise of rigid sanitation is necessary to prevent spread of the disease.

DETECTING INTERNAL PARASITES

The fact that all internal parasites have a high rate of reproduction, so that a great many eggs are produced and liberated in the intestine, makes it possible to detect the presence of worms by making microscopic examinations of the feces. The parasitic worm eggs are so minute that they can be seen only by aid of a magnifying instrument. The microscope used should have two sets of lenses, one of which will magnify about 120 diameters and the other of higher power, ranging from 360 to 480 diameters (fig. 7).



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FIGURE 7.—A type of microscope suitable for examining feces for worm eggs.

For practical farm use, an expensive microscope and stand is not necessary, but it is important to have lenses of good quality. All microscopes are delicate instruments and should be handled with great care. Rough treatment may make the adjustments permanently worthless and ruin the mechanism. It is important to follow carefully the detailed directions for their use given by manufacturers and dealers.

The usual procedure in routine examinations for worm parasitic infestations is to place the fecal specimen in a jar with about a pint of water. The sample is then completely broken up by vigorous shaking or stirring so as to liberate any eggs from the adherent material. The mixture is then strained through a fine sieve or one or two thicknesses of fine cloth in order to remove the coarse parts. The liquid filtrate, which passes through along with the microscopic eggs, is collected in a suitable dish or pan. A round-bottomed evaporating dish is preferred. If the filtrate thus collected is of a muddy appearance, it is then advisable to pour off the top portion slowly after it has set 5 or 10 minutes and replenish with clear water, repeating this process until the product is reasonably clear. The eggs will remain in the bottom.

The last washing should be poured into a tall narrow vessel, such as a test tube or graduate. The eggs are heavy and gravitate to

the bottom rather rapidly. In 10 to 25 minutes after the fluid is placed in the slender vessel, a drop or two can be taken from the bottom of the sediment with a small glass tube or a clean straw and placed on a flat piece of glass, spoken of as a slide, for examination under the microscope.

Another method of separating the worm eggs is to break up a quantity of feces in a saturated solution of common salt or sugar. Since water containing all the soluble salt or sugar it will hold is heavier than worm eggs, these will float to the top. The mixture should be allowed to stand for 15 or 20 minutes, after which the eggs may be removed by touching the clean surface of a glass slide to the surface of the fluid. By turning the slide over, the adhering eggs will be on the upper surface and can then be studied under the microscope.

It is impracticable in a publication of this nature to explain how to identify the various parasitic eggs seen on the slides. The photographs taken through a microscope, shown as figures 4, 5, and 6, however, will help the novice recognize the eggs of different species. Personal coaching by one familiar with their appearance is of great aid in this matter.

EXTERNAL PARASITES

Insect and other parasites living on the skin of fur animals are the cause of definite abnormal conditions and thus are disease-producing agencies. They thrive on the blood and tissues of the host, causing a loss of vitality and more or less extensive local irritations.

FLEAS

Fleas at times become exceedingly numerous on foxes, the most common species being the dog flea (*Ctenocephalus canis*). Almost every fox ranch has a few of these insects, but under certain conditions they become so plentiful as to be a constant source of annoyance to the animals. Heavy flea infestations cause rapid deterioration of the fur and gradual loss of flesh. Fleas living on animals reproduce by depositing eggs, which fall in the bedding and litter. Here the larvae hatch and, after developing through the quiescent, or pupal, stage in hidden places, emerge as adult insects and take up a parasitic life on any accessible host.

Keeping kennels and premises clean and frequently replacing the bedding will serve to check reinfestation. Spraying the interior of infested kennels with insecticidal solutions such as kerosene emulsion or 3-percent cresol is effective in destroying the larvae. Affected animals may be lightly dusted with one part derris powder mixed with two parts of some finely powdered substance to act as a carrier, such as flour, talc, or fuller's earth. Several repetitions of this treatment at weekly intervals may be necessary, since adult fleas continue to emerge in the breeding places and get on the animals.

Minks are likewise frequently infested with fleas, the species occurring on these animals being *Ceratophyllus vison*. The treatment recommended for foxes is effective. Some investigators have found that liberal applications of sulphur in bedding, kennels, and nest boxes are effective and furnish a simple means of controlling

fleas on both foxes and minks. Small quantities of derris powder sprinkled in the bedding may also be used but in general this method is not recommended.

LICE

Lice are not often found on silver, cross, or red foxes, but on blue foxes, sucking lice of the species *Linognathus piliferus* are often present in considerable numbers, usually in infestations about the eyes and other parts of the head. The parasites spend their entire life on the host animal, attaching the eggs to hairs so firmly as to make it almost impossible to remove them from pelts that are being prepared for market.

Infestations confined to the head may be treated with applications of 2-percent compound solution of cresol. Since poisoning by absorption may occur from this treatment, however, it is recommended that the treated areas be rinsed in lukewarm water a few minutes after the application. If the entire animal is treated by immersion, care should be taken to prevent inhalation of the fluid, and the animal should be rinsed in clear water to prevent absorption of the disinfectant.

Minks are frequently parasitized by a species of biting louse (*Trichodectes retusus*). In addition to the blemishes these parasites may produce on the pelts by attaching eggs to the hairs, they cause considerable irritation to the animals and, sometimes, loss of fur.

For the removal of biting lice on fur animals, several forms of dusting powder are reasonably effective. Powdered derris, with two parts of some inert powder, such as cornstarch or fuller's earth, used repeatedly at weekly intervals, is satisfactory.

BODY MANGE

Mange on the body is rarely found in ranch-raised foxes, though a few outbreaks of sarcoptic mange, as well as of follicular mange, have been observed. Ordinarily, the infection is not recognized until it is in an advanced stage. Successful treatment is difficult, especially in winter. It is advisable to clip the animals so that the preparations used may reach the skin. Soluble lime-sulphur dip is recommended. Since the mites causing mange have usually spread farther than the visible lesions indicate, it is important to treat the entire animal. Repeated treatments at weekly intervals are called for until the attendant is satisfied that complete cure has been effected. Animals under treatment should be kept in a warm place to prevent chilling, and they should not be allowed to come in contact with healthy stock.

Ordinarily fur farmers find that it is more economical to dispose promptly of foxes or minks that are affected with mange than to try to treat them and run the risk of having the infection reach other animals. It is essential that the attendants use every precaution of quarantine and disinfection to prevent a spread of the disease.

EAR MANGE

Ear mange in foxes, which is caused by the mite *Otodectes cynotis*, is easily spread among animals that are in close association. The

mites reproduce rapidly when they become established in the outer ear cavity. The skin irritation brought about by their presence causes an excessive production of the waxy secretions, which, when combined with exuding serum and blood, form heavy crusts and scabs. Holding the head to one side, turning in circles, scratching the ears, and shaking the head, or a drooped condition of the ears are outward symptoms.

Because of the ease with which this parasite is spread, a large proportion of the stock on a ranch is usually affected before its presence is detected. To get rid of the infestation simultaneous treatment of all the animals on a ranch is necessary. The mites are not found buried in the live tissues but are lodged under the superficial scales and the scabs. Hence they are rather easily reached and are readily killed by many medicinal preparations. Since the secretions are waxy, aqueous preparations are not desirable. After removal of the crusts and scabs by means of blunt forceps, an oily application such as one of the following should be used:

Iodoform, 1 part; ether, 10 parts; cottonseed oil, 25 parts.

Oil of cade, 1 part; cottonseed oil, 8 parts.

Carbolic acid crystals (phenol), 2 parts; cottonseed oil or liquid petrolatum, 98 parts.

The mixture should be applied with a cotton swab in such manner as to reach all parts of the ear cavity. It may be necessary to repeat the treatment in 10 to 14 days to insure killing all the mites. In the removal of scabs or debris care should be taken not to injure sensitive tissues.

NUTRITIONAL DISTURBANCES

On fur farms, errors in feeding upset the digestion of the animals, and the nutritional diseases thus caused frequently present serious problems. Some of the disturbances become so pronounced as to cause abnormal conditions in the tissues as well as in the gross body structures. Although research and practical experience have largely standardized the general practices of feeding fur animals, there are many modifications of accepted feeding schedules that may lead to trouble.

RICKETS

Rickets is a disease resulting from a deficiency or unbalance of certain essential elements in the ration and is indicated by unthriftiness and lack of normal bone formation. It is especially noticeable in foxes 5 weeks to 10 months old and is characterized by deformities of leg and tail bones, but irregularities may be in evidence in the backbone and chest bones also. Affected animals have grotesque proportions, being usually short-bodied and potbellied, with enlarged joints. In bad cases the malformations make walking difficult.

In advanced cases it is better to destroy the animals than to try to effect recovery. The disease can be prevented, and in pups most cases can be corrected by proper diet. A deficiency of vitamin D is the underlying cause of rickets. Feeds should be supplied that contain liberal quantities of this vitamin, provided a ration containing the other necessary tissue-building elements also is furnished. In

other words, the addition of vitamin D to the average ration makes calcium, phosphorus, and other bone-building elements assimilable in proper proportions.

Egg yolks are high in vitamin D content and thus are useful in preventing and curing rickets. Cod-liver oil is an excellent source of vitamin D, and many fur breeders use ample quantities of it in a well-balanced ration to prevent rachitic disturbances.

Since young animals may be born with a deficiency in the body store of vitamin D as a congenital defect, liberal quantities of a potent brand of cod-liver oil should be given to vixens some weeks before the breeding season, and the treatment should be continued through the lactation period.

URINARY CALCULI

In penned fur animals, especially in minks, it not infrequently happens that calculi (stones) develop in various parts of the urinary system and cause severe disturbances and often death. These are hard, stonelike casts, consisting largely of deposits of calcium. In the urinary bladder they may be an inch in diameter and completely fill the organ. In some instances a number of smaller concretions may develop in the kidneys, the ureters, or the urethra, causing an inflammation of these organs and degeneration and sloughing of the tissues.

Affected animals exhibit a distressed state, with ruffled fur and gradual loss of flesh. There follows a continued dropping of urine and a constantly wet condition of the fur around the external urinary organs. If the condition persists, there is a loosening of fur and intense local irritation of the skin, especially in the males.

It was formerly thought that an excess of lime and other elements in the food and drinking water was responsible for the development of urinary calculi. Recent investigations, however, have shown that certain deficiencies may be responsible, particularly of vitamin A. An insufficiency of this element in the diet of test animals will promote the formation of urinary calculi. When there is a deficient supply of vitamin A, degenerative changes occur in the tissues lining the urinary tract, and various inorganic elements, such as lime, are not properly eliminated. Once a small deposit occurs, it is added to rather rapidly. On the other hand, X-ray photographs of test animals demonstrate that formed calculi in some cases may be dissolved and removed by the addition of the necessary quantities of vitamin A in the ration.

Preventive as well as curative treatment in these cases may require that the ration be so adjusted as to provide a properly balanced diet. Vitamin A may be supplied in the form of cod-liver oil, dairy products, eggs, liver, and leafy vegetables.

FOOD POISONING

Food poisoning in ranch-raised animals is of not infrequent occurrence. It is usually caused by poisonous substances called toxins that are produced in meats and other protein foods during the growth of certain bacteria. A large group of animals may be affected at the same time if all have eaten the same contaminated food.

Excessive quantities of chemicals or substances not ordinarily eaten by fur animals also have been reported as causing sickness on fur ranches. Disinfectants, paints, and salt have been taken in such quantities as to seriously and sometimes fatally affect foxes and minks.

Affected animals should be given soft gruels as sustaining feeds. Usually little can be done to hasten the elimination of any type of poison from the system once it has been absorbed sufficiently for symptoms to be noticed. Emetics or a stomach pump may be employed to prevent the absorption of any material remaining in the stomach. After the stomach has been emptied, a saline laxative, such as Epsom salt or Glauber's salt, is recommended.

A characteristic paralysis has taken heavy toll on several fox ranches where frozen fish have been fed. In this form of paralysis a definite rigidity or stiffening of the muscles was apparent, which lasted for a period of 1 to 4 days before death. The first symptom is a stiff, stilted gait, which grows progressively more pronounced. It has not been possible to transmit the disease experimentally from affected animals to healthy stock by inoculation, but it appears to be definitely associated with the use of uncooked fish in the ration. On autopsy microscopic hemorrhages may be found in the brain, but the actual cause of the trouble has not been determined.

DIGESTIVE IRREGULARITIES

Digestive irregularities in foxes and minks may result from an unbalanced diet or from improper proportions of foods that otherwise would be wholesome. Either condition may interfere with the secretion of digestive fluids, the assimilation of digestible nutrients, or the elimination of waste. Excessive quantities of fats or oils in the ration, particularly vegetable oils, likewise interfere with stomach digestion and intestinal functioning. Live yeasts, well mixed with foods containing certain carbohydrates, may result in bloating, through rapid fermentation and profuse formation of gas in the stomach and intestine. This condition may also follow the use of certain feeds, even though no yeast may have been deliberately added, for various yeasts and molds, as well as gas-forming bacteria, are present in many substances unless recently sterilized and kept free from contamination. Under ordinary atmospheric moisture and summer temperature certain feeds stored in bags or in bins, especially feeds containing molasses, may become good culture media for some of the active gas-forming organisms.

Some feed manufacturers, as well as many fur-farm superintendents, have attempted to supply what they consider a deficiency of mineral matter by incorporating excessive quantities of crude mineral substances in the ration. Often these do considerable harm by irritating the delicate mucous membranes lining digestive organs.

Continued licking of the fur during the shedding period is likely to result in an accumulation of hairs in the digestive tract. Sometimes these mat and completely obstruct the small intestine.

In certain food deficiencies, especially in an absence of the necessary quantities of phosphorus, magnesium, and iodine, a depraved appetite, spoken of as pica, develops. In this condition, animals will eat bedding material, gravel, sand, and various other forms of

debris. The cure, obviously, is to correct the ration by supplying the deficiencies.

INJURIES AND WOUNDS

Fur animals are especially susceptible to infection when there is an abrasion in the skin. This is partly due to the density of the fur, which prevents free aeration and exposure to sunlight. Minks are particularly apt to develop abscesses under the skin about the head and neck from very slight injuries. It is not unusual, however, to find abscesses on any part of the body.

Skin abrasions should be cleaned, and if they are in the nature of deep puncture wounds care should be taken to leave an opening for drainage. In some instances it may be necessary so to enlarge the opening that it will not close or become sealed with secretions before the deeper part heals and is free from pus-forming organisms. If the lacerations are extensive the edges of the skin should be drawn as nearly as possible to the original position by stitches so arranged that they may be removed when no longer required.

In the case of broken leg bones, properly adjusted splints are valuable in aiding the knitting of the broken ends. In young stock, the mending of broken legs takes place with little trouble if the fractured ends have not punctured the skin and allowed the entrance of pathogenic organisms. In older animals healing occurs more slowly and greater care is required in the adjustment of splints. It is frequently necessary to amputate a badly mangled leg, especially if the skin is broken.

DESTRUCTIVE VICES

Almost every fur farmer has at one time or another been annoyed by the destructive vices of certain individuals. One of the most common is that of fur or tail chewing, which sometimes assumes the form of actual self-mutilation by the destruction of part or all of the tail. The cause of this vice is not known, but it appears probable that the habit may be aggravated by a heavy flea infestation. Many observers attribute it to food irregularities or deficiencies, combined with unfavorable environment, such as abnormal temperature or excessive dampness or dryness, causing a local eczema. Experimental work will be required to determine the underlying cause of such abnormal behavior.

Another vice that is not understood is one of vixens that carry their young about the pens and kill them. This is presumed to be a manifestation of a nervous disturbance, probably brought about by some abnormal state of health, by some exciting factor, or by improper feeding or housing. In some instances, the practice has immediately followed unusual annoyances, such as the presence of flying airplanes or the barking of dogs in the vicinity at whelping time. Since, however, it is often impossible to determine the exact cause of this vice and since, once begun, it is likely to be continued year after year, the animals concerned should be pelted.